PCMAG.COM

By M. David Stone | May 7, 2013

Color Brightness: What It Is, Why It Matters

Summary excerpts

"Color brightness, color light output, or simply CLO...has an excellent pedigree, as part of the Information Display Measurements Standard "

"[The standard] was developed by the International Committee for Display Metrology (ICDM), which is part of the Society for Information Display (SID), in cooperation with the Video Electronics Standards Association (VESA). All of which makes it a pretty definitive standard."

"Differences in image brightness are a big part of why color brightness is worth knowing about"

The DLP projector's color brightness is only 21 percent as much as the 3-chip 3LCD projector.

"Almost all (DLPs) boost their brightness for white light--which is what ANSI lumens measures--by adding one or more additional panels beyond red, green, and blue"

"The difference in color brightness, however, was huge, with the LCD projector delivering essentially the same number for color brightness as for white brightness, and the DLP projector coming in at just 680 lumens, or about 21 percent of its measurement for white light."

"What these results confirm is that, as a practical matter, if you're showing primarily black and white images like word processing documents or spreadsheets, DLP and LCD projectors with the same ANSI lumen measurements will both be equally bright. For color images however, whether PowerPoint slides or photos, the LCD projector will be brighter."

PCMAG.COM

Color Brightness: What It Is, Why It Matters

By M. David Stone | May 7, 2013

As you may have noticed, there's a (relatively) new spec for projectors in town, variously called color brightness, color light output, or simply CLO. Whatever you call it, is has an excellent pedigree, as part of the Information Display Measurements Standard version 1.03 (IDMS 1), dated June 1, 2012. IDMS 1 was developed by the International Committee for Display Metrology (ICDM), which is part of the Society for Information Display (SID), in cooperation with the Video Electronics Standards Association (VESA). All of which makes it a pretty definitive standard.

As you may also have noticed, Epson recently began touting its LCD projectors as having three times brighter colors than "leading competitive projectors." The claim also applies more broadly to any projector using 3LCD technology, which means a light engine with three LCD chips, with one each for the red, green, and blue primary colors.

The competition Epson is referring to is the universe of DLP projectors that use a single

DLP chip (which I'll refer to simply as DLP projectors). The claim is based on the typical difference in color light output between a 3LCD projector and a DLP projector that both have equal brightness in ANSI lumens, which measures white light output. The problem with the claim is that although it's both true and meaningful, it's also easy to misunderstand.

Why Three Times as Bright Isn't Three Times as Bright

The first issue is that brightness is actually the wrong word, although almost everyone uses it this way (and I'll continue to use it through the rest of this discussion). Technically, however, brightness refers strictly to perception, so how bright something is means how bright it looks. The intensity of light that's coming out of the projector is more properly called illuminance.

The difference matters because perception of brightness is logarithmic. Triple the illuminance of a projector, and the same size image will look brighter, but nowhere near three times as bright. So what Epson is actually claiming is that its 3LCD projectors typically deliver color with three times the illuminance of DLP projectors with the same ANSI lumen rating, not three times the brightness in the technically correct definition of brightness.

A second semantic issue is that you can also use brightness as a term for describing color quality. In fact, the hue-saturation-brightness color model uses brightness as one of the three parameters for describing any given color, with a vibrant yellow, for example, qualifying as brighter than a less vibrant version of the same yellow hue.

What makes this second issue particularly problematic is that a projector's color brightness actually does tell you something about its color quality. However, the relationship between the color brightness and color quality is complicated. Because of that, I will ignore issues of color quality for the rest of this discussion, and cover them separately. What I'll concentrate on here is the difference in color brightness measurements between 3LCD and DLP projectors.

Where Brighter Colors Come From

The reason for the difference in color brightness between the two technologies is easy to understand. Projectors with 3LCD technology simply add red, green, and blue together to create white. So if you measure the lumens for red, green, and blue separately, and then add them up, the total will be the same as the industry-wide ANSI lumen measurement for white.

In contrast, DLP projectors create colors by projecting one color at a time, in sequence. The vast majority use a rotating color wheel, shining light through color panels on the wheel. Almost all boost their brightness for white light--which is what ANSI lumens measures--by adding one or more additional panels beyond red, green, and blue, typically using some combination of white (a clear panel), cyan, and yellow. If you measure the brightness for red, green, and blue with these projectors, and then add up the measurements, the total will be less than the measurement for white by however much the additional panel or panels add to the total ANSI lumen measurement.

Different DLP projectors use different color wheels, with a variety of both arrangements of color panels and proportion of color-panel colors they use to create various colors on screen. Even with a given projector, the proportions change depending on the color mode you're using, which is why colors look different with different color modes.

This means that the ratio between white light output and color light output will vary from one DLP projector to another, and even, for the same projector, from one color mode preset to another. In one set of tests with business projectors in the 2000 to 3500 lumen range that the 3LCD Group provided, the actual level of color

light output as a percentage of white light output for any given DLP projector ranged from about 20 to 60 percent. My own tests have turned up an even larger range, with color light output running from about 20 percent to well above 80 percent of the white light output for any given projector.

On average, however, the 3LCD Group says the ratio between white brightness and color brightness is about three to one, compared with one to one for 3LCD technology. All of which is the basis for Epson's claim of offering three times brighter color.

A Real-World Example

To get an actual example of the difference between an LCD and DLP projector with the same ANSI lumen rating, I tested one of each. Both are rated at 3000 lumens, and both came in a little higher on my tests, at 3087 lumens for the LCD projector and 3198 lumens for the DLP projector. For projectors in the 3000-lumen range, the roughly 110-lumen difference is far too little to be noticeable. In fact, it's within the error range for the tests.

The difference in color brightness, however, was huge, with the LCD projector delivering essentially the same number for color brightness as for white brightness, and the DLP projector coming in at just 680 lumens, or about 21 percent of its measurement for white light.

I also measured the brightness for both in the best color quality mode for each, using Theater mode for one and the equivalent Movie mode for the other. Both projectors came in at about the same brightness for white light for these modes too, at about 2000 lumens, and here again the LCD projector offered the same results for both white brightness and color brightness. The DLP projector did relatively better on color brightness than in its brightest mode, but still came in at a much lower number, with color brightness at 794 lumens, or 39 percent of its white brightness for Movie mode.

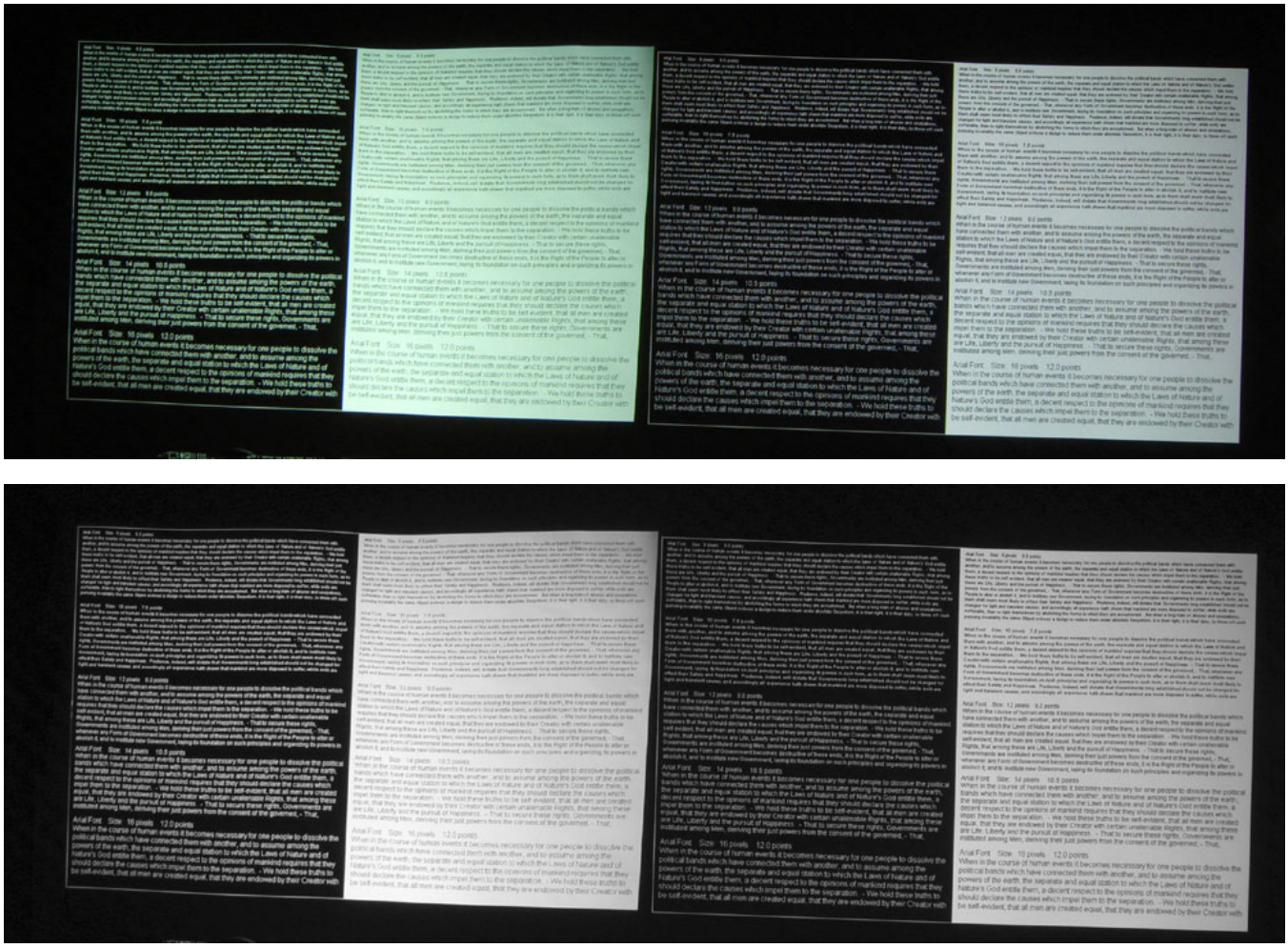
The Practical Difference in Brightness

What these results confirm is that, as a practical matter, if you're showing primarily black and white images like word processing documents or spreadsheets, DLP and LCD projectors with the same ANSI lumen measurements will both be equally bright. For color images however, whether PowerPoint slides or photos, the LCD projector will be brighter.

To prove the point, I set up the two projectors side by side and took photos, shown below, of some of the DisplayMate images we use for testing as well as some additional images. In each case, I've also included two versions of each photo, with the original in color followed by the same photo modified in Photoshop to remove the color information. The second version makes it a easy to focus specifically on brightness, without your sense brightness being affected by color.

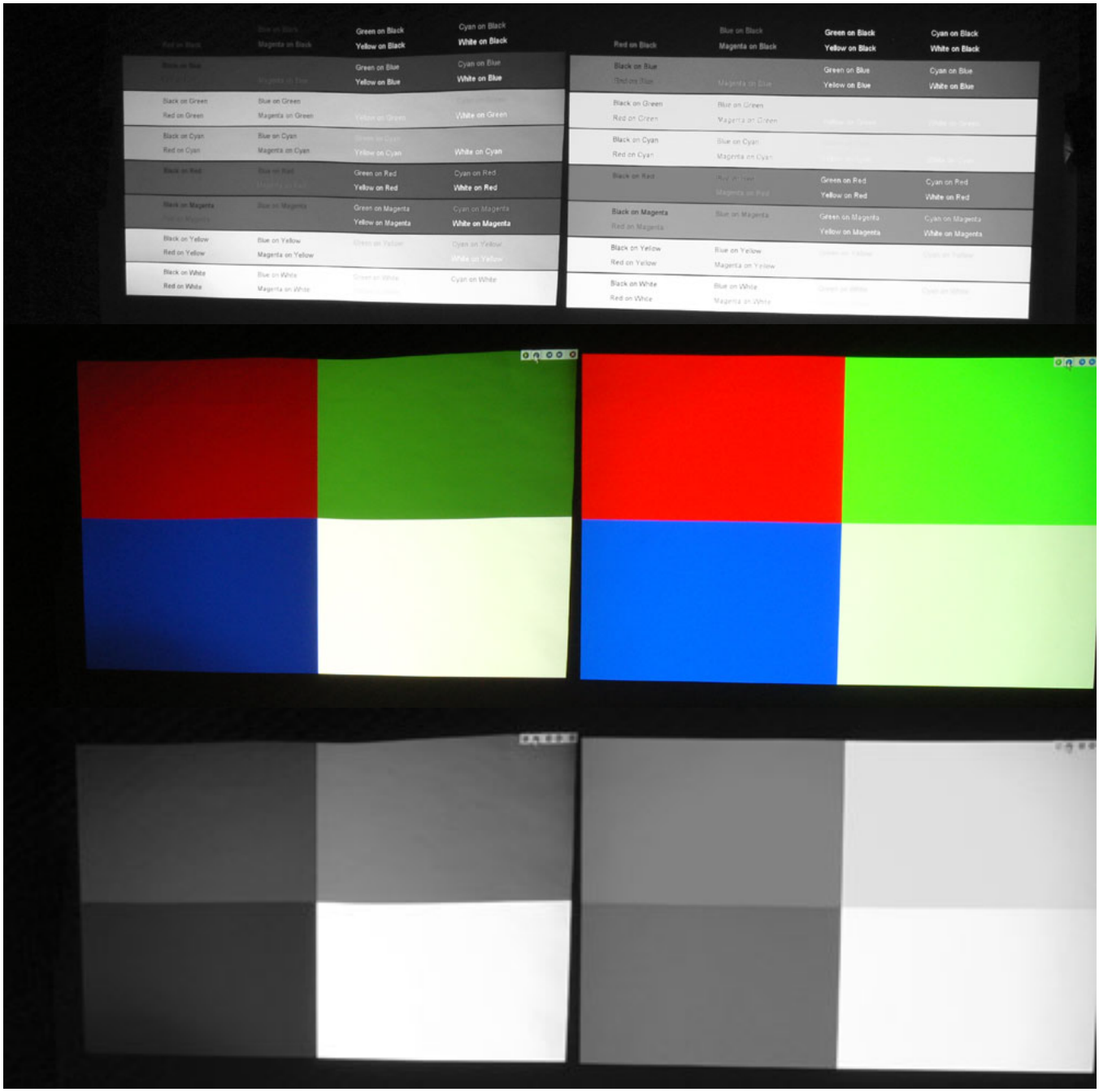
Keep in mind that because camera sensors don't see brightness or color quite the way the human eye does, and because colors and brightness can also change somewhat depending on the computer monitor you're using, the third generation images as you see them aren't quite the same as the originals that show on the projector screen. In particular, on my computer screen, at least, white shows as a touch brighter for the DLP projector, even though I measured the two as essentially equal brightness. That said, the photos are close enough to the originals to be reasonably good representations of what the originals look like.

The first set of photos below, shows both black text on a white background and white text on a black background (click on the images to enlarge).



As you can immediately see in the second version of the photo, the image from the DLP projector on the left is easily as bright as the image from the LCD projector on the right. In fact, the DLP projector's image is a little brighter in this case, primarily because the white characters on black are thicker with the DLP projector than with LCD projector, and the black characters on white are thinner, making the overall image brighter.

The photos below show what happens with a color image.



Here again, there's little brightness difference for white, but a substantial difference for each of the colors. On the other hand, also note that if you compare the relative brightness for the red, green, and blue areas, the DLP projector is a lot more than one fifth as bright as the LCD projector to the human eye, even though it's color brightness is only 21 percent as much.

These differences in image brightness are a big part of why color brightness is worth knowing about when you're trying to determine a projector's brightness, which, in turn, determines how big an image you can use in a given level of ambient light. The other reason color brightness matters is because of the issue I mentioned earlier, namely, that color brightness can also tell you something about color quality. To my mind that's actually far more important than the question of brightness as such, but I'll save that for a separate discussion. Stay tuned.

About the Author; M. David Stone

Lead Analyst Printers, Scanners & Projectors m.david.stone@verizon.net

M. David Stone is an award-winning freelance writer and computer industry consultant. Although a confirmed generalist, with writing credits on subjects as varied as ape language experiments, politics, quantum physics, and an overview of a top company in the gaming industry. David is also an expert in imaging technologies (including printers, monitors, large-screen displays, projectors, scanners, and digital cameras), storage (both magnetic and optical), and word processing. He is a recognized expert on printers, well known within the industry, and has been a judge for the Hewlett-Packard HP Invent Awards.

His more than 30 years of experience in writing about science and technology includes a more than 25-year concentration on PC hardware and software. He has a proven track record of making technical issues easy for non-technical readers to understand, while holding the interest of more knowledgeable readers. Writing credits include nine computer-related books, major contributions to four others, and more than 4,000 articles in national and worldwide computer and general interest publications. His books include The Underground Guide to Color Printers (Addison-Wesley) Troubleshooting Your PC, (Microsoft Press), and Faster, Smarter Digital Photography (Microsoft Press).

Much of David's writing has been for PC Magazine and PCMag.com. He has been a frequent contributor since 1983, a Contributing Editor since 1987, and Lead Analyst since 2004. His work has also appeared in a number of other print and online magazines and newspapers, including Wired; Computer Shopper, eWeek, and Science Digest, where he was Computers Editor. He also wrote a column for the Newark Star Ledger for several years.

Non-computer-related work runs the gamut from the Project Data Book for NASA's Upper Atmosphere Research Satellite (written for GE's Astro-Space Division) to occasional science fiction short stories. (His work has appeared in Analog.) After being born in and spending most of his life in or near New York City, David moved to Pennsylvania several years ago, but still considers himself a New Yorker, and refuses to give up the New York area code on his cell phone.